# PM3001188006

# EFFECT OF DISTRIBUTION OF VENTILATION ZONE COVERAGE BY LIPS ON TAR YIELDS

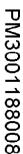
Full Flavor Yield (% Smokers	Lights Yield (% Smokers	Ultra Light (% Smokers)
11.9 (48)	6.7 (64)	2.2 (55)
12.0 - 12.4 (43)	6.8 – 7.2 (22)	2.3 – 2.7 (13)
12.5 – 12.9 (5)	7.3 – 7.7 (10)	2.8 – 3.2 (11)
		3.3 – 3.7 (7)





### MEASUREMENT BASED ON "CO BOOST'

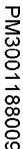
- "CO Boost" is the increase in CO in the exhaled air of the smoker immediately after taking one puff compared to immediately before smoking
- Results indicate 50% is all that can be blocked with the lips, consistent with Röper's image analyses





### **SUMMARY**

- Butt stain patterns indicate only 4% completely blocked; <29% partial. Butt stain patterns can only be used to determine blocking or no-blocking, not extent.
- What subjects do and what they think they do are quite different
- Only 11% of 133 British subjects had their fingers in contact with the cigarette during one or more puffs of the smoking cycle.





### SUMMARY (cont.)

- Insertion depths range from 3 25 mm, with a mean of 10.1 11mm.
- Complete blockage of the ventilation zone of the lowest yield cigarettes results in a 5-fold increase in TPM. This is "clearly massive" in comparison to the TPM yields obtained for partial blocking that occurs in practice for some smokers

# A Review





### **OBJECTIVE**

- Share knowledge on vent hole blocking with CE
- Provide information needed for decision-making in future studies



### SOURCE FOR THIS PRESENTATION

- "Filter Ventilation—Has There Been a Cover-up?" by Richard Baker (BAT) and Leslie Lewis (RJR) presented at 1997 TCRC (invited Symposium talk); published in Recent Advances in Tobacco Science
- Review, not critique, of this paper
- Includes published and unpublished results





### **BACKGROUND**

- Filter ventilated cigarettes introduced in 1960s to reduce yields
- In addition to smoke dilution, filter ventilation affects combustion processes, particulate filtration, and gaseous diffusion



### BACKGROUND (cont.)

"Since the early 1960s a number of studies . . . have been interpreted to imply that more than 50% of smokers of ventilated cigarettes block the ventilation holes. . ."





### PUBLISHED LITERATURE

- Kozlowski (Dept. of Behavioral Health, Penn State) most prolific
- Kozlowski anecdote
- Three categories
  - Methodology
  - Incidence
  - Effect on smoke yields

# PUBLISHED LITERATURE: METHODS





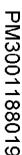
# KOZLOWSKI PUBLICATIONS ON METHODS (1980)

- Visual, "after-the-fact"
  - Lipstick stain on the filter
  - Filter-end staining pattern
    - Bull's eye indicates no blocking
    - Heavy stain across entire filter indicates blocking
    - Light stain across entire filter indicates partial blocking
  - Interviews indicated "32—69% of low tar smokers have blocked ventilation holes"
    - <4 mg tar yield Canadian cigarettes</p>
    - FDA



# KOZLOWSKI PUBLICATIONS ON METHODS

- Second Kozlowski study (1982)
  - 46 smokers observed
  - Period of observation not known
  - Compared observation of smoking event with filter staining patterns:
    - 39 evaluable subjects
    - 4% probably not blocked, 44% partially blocked but "impossible to judge with any confidence"; 15% "probably blocked very effectively; 37% not accounted for in paper





# LOMBARDO PUBLICATIONS ON METHODS

- Lombardo et al. (1983)
- Investigation of accuracy of raters and comparison of human smoked cigarettes and machine smoked cigarettes

<u>Condition</u>	Correctly Rated
Unblocked	79%
Partially blocked	52%
Completely blocked	90%





## LOMBARDO PUBLICATIONS ON METHODS

■ Lombardo et al. concluded that Kozlowski's 39—69% of smokers blocking may be too small, but added that "[i]t is possible that, even with trained raters, the detection of ventilation hole blocking in smokers may prove *too* unreliable to be useful" (emphasis in original)





# ZACNY AND STITZER PUBLICATION ON METHODS

- Zacny and Stitzer, 1988
- 10 smokers, "high-yield" cigarette smokers; forced switching in random order to 4 similar pressure drop cigarette brands yielding 0.1 to 1.1 mg smoke nicotine (FTC)





# ZACNY AND STITZER PUBLICATION ON METHODS

- Could not distinguish (with the four stain categories) between unblocked and partially blocked vents for 0.4 to 0.7 mg nicotine yield cigarettes
- 1600 returned butts from the 0.1 mg brand

Completely blocked	0.1%
Partially blocked	6%
Questionable	22%
Unblocked	72%





# KOZLOWSKI PUBLICATIONS ON METHODS (1988)

- Collected ~1000 butts from public ashtrays in Toronto
- Sorted into 135 filters of "low-yield" (FTC tar ≤ 4mg)

Extremely blocked	19%
Partially blocked	39%
Unblocked	42%





# KOZLOWSKI PUBLICATIONS ON METHODS (1989)

- 14 ultra-low tar smokers
- Smoked on-site
- 50% reported to have blocked at least some of the vents; 21% considered complete
- 86% said they never blocked the vents
- 2 smokers who self-identified as blockers were not observed to do so





# KOZLOWSKI PUBLICATIONS ON METHODS (1994)

- Pillitteri first author
- Filter stain methodology
- Cigarettes of 9 12 mg tar; machine smoked unblocked, 50% blocked; 100
  blocked; and first 5 puffs 50% blocked and second 5 puffs completely blocked
- Three best raters agreed 91.7% of the time for light cigarettes and 77.8% of the time for ultra-light cigarettes



# KOZLOWSKI PUBLICATIONS ON METHODS (1994)

- 158 cigarettes from outdoor ashtrays on an American college campus
- Filter stain methodology
- "light" cigarettes: 8
   12 mg FTC tar;
  85% from one cigarette brand

Completely blocked	27%
Partially blocked	26%
Unblocked	47%





# KOZLOWSKI PUBLICATIONS ON METHODS (1996)

- Random digit dialing phone survey of 788 smokers in the U.S.
- 218 ultra-low; 316 light; 210 regular
- 39 47% neither seen nor heard about filter vents
- Conclusion: >67% unaware of vents or consequences of blocking vents
- 10% (ultra-low and light) 18% (regular) knew; 41 -- 51% (of 10%) used fingers; 16 36% (of 10%) used tape; 0 7% used lips





# KOZLOWSKI PUBLICATIONS ON METHODS (1996) (cont.)

Fingers	49 smokers	
Tape	34 smokers	
Lips	7 smokers	

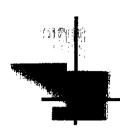
•788 total smokers in study; ~96 knew about vents





# KOZLOWSKI PUBLICATIONS ON METHODS (1996)

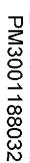
- "...the stain pattern technique is best suited to detect presence versus absence of vent blocking rather than the extent of vent blocking."
- Supported by work of Helms (1983, 1984), which demonstrated that filter stain pattern depended on degree of ventilation, number and size of holes, number of rows, depth of holes



### BAKER AND LEWIS CONCLUSION

". . .the presence or absence of a distinctive "bull's eye" staining pattern, as used by Kozlowski and co-workers, is not necessarily related to the incidence of vent blocking."

# VIDEO-TAPED OBSERVATIONS





### FERRIS PUBLICATION (1983)

- 3 British cities; 133 smokers; £3 recompense
- One-on-one interviews conducted by psychologists from University of Wales
- (137 interviews: three would not smoke; one refused to be taped)

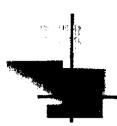




### FERRIS PUBLICATION (1983) (cont.)

- 798 puff assessed; omit lighting puff
- 81% of total puffs: no finger contact
- 64% of final puffs: no finger contact
- 12% of puffs included finger contact for part or all of puff; 26% during final puff
- 10% could not be determined from the video





### FERRIS PUBLICATION (1983) (cont.)

- 15% had fingers in contact for one or more puffs
- 4% had fingers in contact for all puffs
- "fingers in contact" does not necessarily mean with vent hole region
- Systematic interview data in accord Kozlowski findings, but contrary to observed behavior with respect to finger blocking. (emphasis in original)



### **BAKER AND LEWIS CONCLUSION**

 "What subjects do and what they think they do in this case are quite different." (emphasis in original)

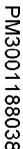
# MOUTH INSERTION DEPTH STUDIES





## METHODS FOR EVALUATING INSERTION DEPTH

- Lipstick prints (presumably limited to females)
- Detection of  $\alpha$ -amylase in dried saliva
- Detection of amino acids in dried saliva
- Measurement from television screen when replaying videotapes





## RESULTS FROM MOUTH INSERTION DEPTH STUDIES

- Mean values between 10.1 and 11.5 mm (excludes videotaped measurements)
- Range 3 25 mm
- Insertions depth not seen to differ between ventilated and non-ventilated cigarettes
- Relatively constant over 20 years and across four countries
- Average difference between max and min for a given smoker = 3 – 5 mm in a given puff





# CALCULATED VENT BLOCKING BASED ON MOUTH INSERTION DEPTH MEASUREMENTS

 Based on 1997 Canadian insertion depth distribution of 2232 butts

	% Smokers Achieving		
Vent Zone Position (mm)	No	Partial	Complete
10	53	39	8
12	72	25	3
14	84	15	1
18	97	3	0



## RESULTS OF IMAGE ANALYSIS OF LIP IMPRINTS (unpublished results, 1997)

- Study by Röper of Reemtsma
- Maximum ventilation hole coverage in a given puff is ~50% for those smokers who cover the vents

# CIGARETTE VENTILATION AND EFFECTS OF PARTILATION AND EFFECTS OF PARTILATION AND



### **OVERVIEW OF RELEVANT PHYSICS**

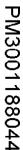
- Non-linear relationship between air flow through perforated paper and the pressure drop across the paper (6 ref)
- Relationship between filter ventilation and effective air permeability of the filter ventilation zone is non0-linear
- Effective air permeability of ventilation zone depends on number of holes
- Relationship between degree of blocking and filter ventilation is non-linear





### **MORE PHYSICS**

Non-linearity increases as filter ventilation increases: Blocking 50% of the holes of a 20% ventilated filter reduces the ventilation from 20% to 12% (40% reduction), but blocking 50% of the holes of a 90% ventilated filter reduces the ventilation from 90% to only about 81% (10% reduction)





## ESTIMATE OF MAXIMUM VENTILATIOIN HOLE COVERAGES

- Lips and fingers
- Maximum coverage by lips in a given puff: 50%
- Maximum coverage by fingers: 25%



### ESTIMATE OF MAXIMUM VENTILATIOIN HOLE COVERAGES: WORST CASE

Zero Blockage Condensate Yield	Max Finger Blockage Condensate Yield	Max Lip Blockage Condensate Yield
1.3 (TPM)	1.6	2.5
2.2 (tar)	2.9	3.5
6.7 (tar)	7.4	8.1